velocity, this forward velocity becoming zero and then negative. With the increase in velocity in the negative direction, the diameters of the spires increase. The electron is thus a prisoner of the magnetic field traveling back and forth between the poles but never reaching either one.

The zigzag path of a cloud of electrons, distorted to fit a plane surface, is shown in fig. 4. Imagine this figure on the surface of a sphere. The lines marked north pole and south pole become points. The reenforced parts, due to the overlapping of the paths, occur along magnetic meridians and the turning points of these paths lie on magnetic parallels.

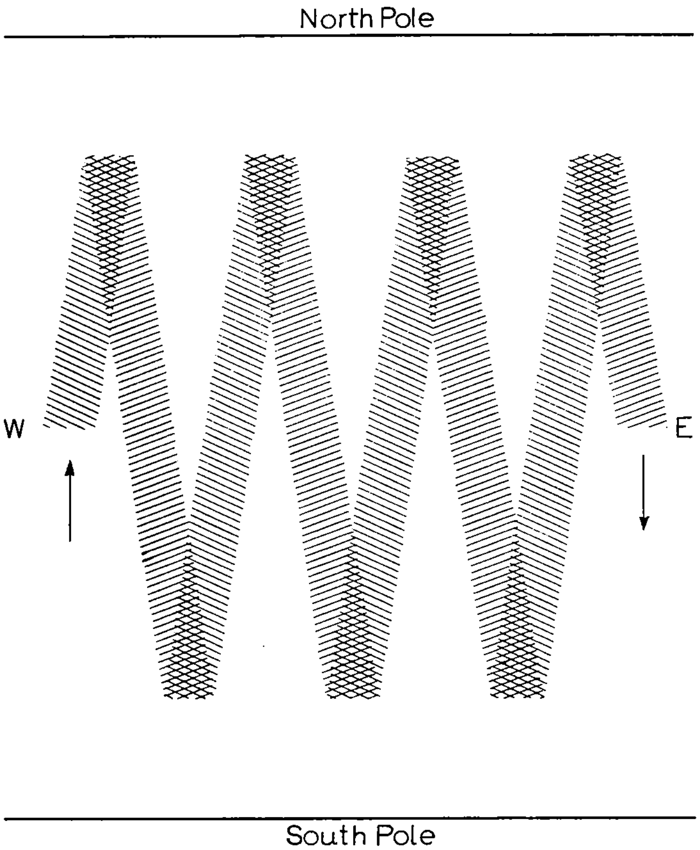

FIG. 4.—Path of a cloud of electrons.

In the glass bulb in which the artificial aurora was produced it was found that where the paths overlapt the light was decidedly more intense. These regions correspond to the auroral rays, which are observed to be parallel to a free magnetic needle. Since these rays terminate on the same magnetic parallel, we have the auroral arch. If the distance between homologous points of two neighboring rays is greater than the width of a ray, we have the fan-shaped aurora; if less, the auroral drapery. The aurora in the north must always be accompanied by one in the south.

The general motion of a cloud of electrons is from west to east (consider fig. 2). The rate of this easterly motion is, for a given magnetic field, a function of the intensity of the electric field, i. e., of the velocity of the electrons. Corresponding to variations of the electric field we shall have, consequently, the rotation of the aurora, to the west in an increasing field, to the east in a decreasing field. Since the distance from the poles of the turning points in the paths of the electrons is a function of the magnetic field strength, variations in this field will cause the north and south motions, the dancing of the rays. This motion will be away from the pole in an increasing field and toward it when the field is decreasing. The artificial dance of the rays was produced by bringing a small bar of iron near one of the poles of the Ruhmkorff magnet, thus causing variations in the field strength.

The chief argument for terrestrial as opposed to solar origin of the cathode rays is the fact that auroras, at altitudes of some hundreds of kilometers from the earth, are sometimes seen as far south as the equator. Admitting that electrons can get away from the sun, those that reach the earth must approach and recede along the almost vertical magnetic lines in the immediate vicinity of the poles of the earth's field, producing an aurora which if visible at all in the lower latitudes would necessarily occur at very high altitudes. The supposed source of the electrons is a cloud under the influence of solar radiation. Other possible sources are mentioned. Since these can occur only on that side of the earth next to the sun, and since the comparatively feeble light of the aurora is not visible until after sunset, more and brighter auroras are seen just after dark than later in the night, the easterly auroral rays being always feebler than those toward the west.

The following articles present a theory also based on the motion of cathode rays in the earth's magnetic field; the chief differences between these theories being that in the latter the sun is the source of the cathode rays.

Notes de M. Carl Störmer.—Sur les trajectoires des corpuscules électriques dans l'espace sous l'influence du magnétisme terrestre, avec application aux aurores boréales et aux perturbations magnétiques. Comptes Rendus, 25 Juin, 1906; 9 Juillet, 1906; et 1 Octobre, 1906.

Note de M. Carl Störmer.—Les expériences de M. Villard et sa théorie des aurores boreáles. Comptes Rendus, 10 Septembre, 1906. This note contains reference to the previous work of Störmer and to the work of Birkeland, to whom is due the hypothesis that the aurora is caused by the motion, under the influence of the earth's magnetic field, of cathode particles which have been projected from the sun.

Note de M. P. Villard.—Sur l'aurore boréale: Réponse à la Note de M. Störmer. Comptes Rendus, 22 Octobre, 1906.

For the purpose of comparing these theories with actual observations, the papers by Prof. Cleveland Abbe, in "Terrestrial Magnetism", March, June, and December, 1898, and a paper by Doctor Chree, in "The Philosophical Magazine", January, 1907, will be found interesting. The first of these treats of the altitude of the aurora; the second compares sunspot and auroral frequencies.

OBSERVATIONS OF HALOS IN ENGLAND.

By M. E. T. GHEURY. Dated Eltham, Kent, January 2, 1907.

My observations of halos have been but casual, and but few were actually recorded; I have always, however, expected wet weather after a solar or a lunar halo. On perusal of my notes, I find but the following records:

(1) London, 15th of December, 1902, 11 p. m., halo of 22° (moon), rather pale, but better defined and plainly visible in its upper half. Rain fell during the whole of the 16th.

(2) Chelmsford (Essex), 4th of October, 1903, 10 p. m., halo of 22° (moon), well defined. Abundant rain the morning of the 5th.

(3) Chelmsford (Essex), 3d of November, 1903, 10 p. m., halo of 22° (moon), well defined. No mention of following weather. A reference to my private diary, however, leads me to believe the next day was rainy.

(4) Chelmsford (Essex), 1st of February, 1904, 10 p. m., halo of 22° (moon), well defined. No mention of following weather, but a similar reference allows me to infer that the next day was gloomy, threatening rain.

(5) Chelmsford (Essex), 30th of December, 1906, noon, halo of 22° (sun), 2 parhelia and adjacent fragments of horizontal circle. I would have expected rain but for the fact that after a night of frost, and a light thaw in the morning, it was beginning to freeze hard again. Nevertheless, *it rained* that evening from 7:30 p. m. until about 9:00 p. m.